A volcano stirs in eastern California

Hikers scrambling down slopes near Mammoth Lakes, Calif., in January may have thought the tendrils of steam rising from geothermal vents on the mountainside added an exotic touch to the already scenic vista. The United States Geological Survey, on the other hand, views increased activity at the steam vents — fumaroles — one of several compelling reasons to issue a notice of potential volcanic hazard, the lowest level of formal concern. The notice was issued May 25.

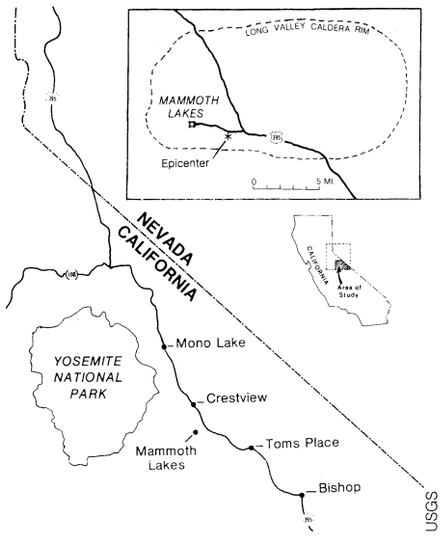
In recent weeks the USGS has stepped up observations at Mammoth Lakes in the southwestern part of the 20-by-30-kilometer Long Valley volcanic caldera in eastern California. The area has a long history of volcanic activity. When the caldera, a basin-shaped volcanic depression, formed 700,000 years ago, it extruded 600 cubic kilometers of material in only a few weeks. Studies show that in the last 2,000 years, smaller eruptions have occurred at roughly 200-year intervals, and usually involved dome building and flows of volcanic material, such as ash. Geologists cannot say what kind of eruption, if any, will occur or when.

One of the early indications of volcanic activity is the incidence of spasmodic tremors, which often are observed in volcanically active areas. The recent sequence of quakes at Mammoth Lakes began in October 1978 with a Richter magnitude 5.7 quake, says Alan Ryall of the seismological laboratory at the University of Nevada in Reno. The seismic activity migrated northward to the Long Valley area, and in May 1980, the laboratory recorded four earthquakes with magnitudes of 6.0 or greater (SN: 6/7/80, p. 356).

"This sequence has had the appearance of a very large earthquake swarm," Ryall says. "The largest earthquakes were not at the beginning of the sequence—it built up and it's still going on." The swarms—clusters of small quakes — were not observed until the large quakes in 1980. Since then, Ryall has noted at least eight instances when hundreds of small earthquakes occurred over an hour or so.

The most recent earthquake swarm (which included at least one quake of magnitude 4.2) occurred May 7 and 8 and led USGS to issue the volcanic hazard notice. The seismic activity appears to be related to movement of magma in the sizable chamber approximately 7 to 8 kilometers below the earth's surface. In contrast, magma under the Mono craters to the north is found at the reassuring depth of 25 km. Jim Savage of USGS in Menlo Park, Calif., said in an interview at the recent meeting of the American Geophysical Union in Philadelphia, that the source of the earthquakes was moving toward the surface from 8 km deep to the recent depth of 3 km.

The shallow source of the tremors may



indicate that a tongue of magma has intruded into the fracture system that rings the caldera. If the super-heated material comes into contact with the water table it could initiate explosions, Ryall says; the level of the water table is still unknown.

Meanwhile, measurements of ground movement and strain also indicate that magma is on the move. Savage reports that part of the caldera floor is uplifted as much as 25 centimeters, and the magma chamber has expanded by 0.15 cubic kilometers. "That's the type of thing they often see in Hawaii, so it's on the scale of volcanic action," he says.

Scientists differ over whether the earthquakes caused the molten rock to move or whether the volcanic activity caused the quakes. With the caveat that "there's not enough data to settle the question," Savage opined that the magma's upward movement preceded the quakes. In support of his views, he cites studies by Wayne Thatcher, also of USGS Menlo Park, who at the AGU meeting described a similar sequence on the Izu Peninsula in Japan. There, ground deformation occurred without seismic activity but unmistakably preceded failure of a major fault in 1980 and the ensuing magnitude 7.0 earthquake.

Other scientists believe that movement of magma at Mammoth Lakes is related to shifting of crustal plates in the region. The seismicity, Ryall says, follows the pattern on the fault along the eastern front of the Sierras. As faulting occurs, confining pressure on the molten rock lessens and the magma seizes the opportunity to rise.

USGS has no immediate plans to upgrade the level of volcanic hazard. Area residents, scientists and civil agency officials will meet at Mammoth Lakes July 6 and 7 to review existing data and the potential magnitude of the volcanic eruptions. —*C. Simon*

Genetic variation: Maine fish swim faster


Smithsonian

The fast-swimming killifish *(Fundulus heteroclitus)* and the enzyme responsible for its athletic prowess have revived an old debate between adherents of the selectionist and the neutralist theories of evolution.

New research shows that genetic variation in the enzyme, lactate dehydrogenase-B, is linked to swimming ability, hatching time and environment adaptability in a species of killifish.

Biologists Dennis A. Powers and Leonard DiMichele of Johns Hopkins University report in the May 28 SCIENCE that killifish with lactate dehydrogenase-B of a specific phenotype or form — LDH-BbBb — hold several advantages over their counterparts with other forms of the enzyme: They swim faster and longer at cold temperatures and adapt better to cold water off the coast of Maine, where they are frequently found. Powers told SCIENCE NEWS: "These fish don't travel very far. They stay about 36 meters from where they were born and must be able to adapt to local conditions."

Killifish with phenotype LDH-BbBb, Powers explains, swim faster because this particular form of the enzyme works better at cold temperatures. By regulating ATP levels, lactate dehydrogenase-B affects the ability of red blood cells to carry oxygen. Fish with the phenotype LDH-BbBb have high ATP levels, which means their red blood cells will give up oxygen molecules readily and deliver oxygen more efficiently to muscle tissue; hence they can swim faster and longer.

In an earlier study reported in the April 8 NATURE, the biologists found that killifish with a different phenotype called LDH-BaBb hatch over a long period of time, giving the tiny fish an advantage in environments likely to trigger an early or late hatching. Killifish with this phenotype are common in waters off the mid-Atlantic coast, where weather conditions change frequently.

According to Powers the results add credence to the selectionist theory of evolution, which says that all genetic variation has meaning and that changes on the molecular level are made to increase chances of survival by making the organism better adapted to the environment.

But Masatoshi Nei, professor of population genetics at the University of Texas, favors the neutrality theory, which says that most known genetic mutations are harmful and do not help the organism adapt to the environment. Nei said in an interview that Powers's results represent an isolated instance where a genetic mutation proved advantageous. —*K.A. Fackelmann*